RECENT TRENDS IN WEATHER SERVICE

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A Radio Talk by Willis Ray Gregg, Chief, Weather Bureau, broadcast 9:30 p.m., Tuesday, June 9, 1936, by station WDAF, Kansas City, Mo.

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Weather is the most talked about topic that the human race possesses. It has been so since the dawn of history, probably for countless ages before. The cave man no doubt scanned the sky carefully each morning, grunted his satisfaction or muttered some primordial oath, and formulated his plans for the day on what his observations revealed. He and his more enlightened successors gradually evolved certain, fairly definite relationships between signs of the sky and other things that they saw and the weather that actually followed. Thus, comparatively early in his history, man became a forecaster as well as an observer. Many of the weather proverbs that he expressed in quaint rhymes have more than a kernel of truth in them and are useful even to the present day.

Broadly speaking, this represents the extent of progress in weather service up to something like a century ago. Owing to the development, about that period, of the telegraph, the discovery of certain fundamental physical laws and the introduction of instrumental apparatus, particularly the barometer and the thermometer, a very active and world-wide interest was aroused in the possibility of adapting weather service to human activities. Almost simultaneously many countries organized fairly extensive networks of observational stations and endeavored to use the data in predicting what the weather would be a day or two ahead.

From that time on, down to the early part of the present century, considerable progress was made in developing new and improved types of instrumental apparatus, in extending the range of observations and in applying the data to the problems of forecasting. Gradually observational stations were established over the entire country and even beyond, including Alaska and the West Indies. Simultaneously Canada, Mexico and many other countries organized similar services and the first steps were taken in effecting an international exchange of reports. Tremendous progress was made in this field with the introduction and use of radio, for this made it possible to receive data from ships at sea, one of the most important developments in the entire history of weather service. Through international conferences arrangements were made for the adoption of uniform methods of making, recording and publishing observations. Moreover, codes for international exchange and symbols for entering the data on weather maps have, so far as possible, been standardized. All of this has resulted in making the data, generally speaking, directly comparable, thus facilitating the study of weather and climate on a world-wide scale.

Meanwhile, increasing attention has been given to the exploration of the upper air, concerning which up to the beginning of the present century practically nothing was known. Kites and manned balloons had their

day. They were succeeded by small free balloons, some of them carrying instruments, and most recently by airplanes which go up quickly to 3 or 4 miles and bring down a complete record of temperature and humidity at all heights reached.

The study of these records in the vertical, together with those in the horizontal, has brought out many useful relationships, our knowledge of the physical processes of the atmosphere has immeasurably increased and, as a result, important advances have been made in the precision and accuracy of forecasts. Notwithstanding all this, we must admit that the surface has, after all, barely been scratched. Much remains to be done to bring weather service to the state of excellence of which it is capable. We believe that such improvement is perfectly possible. We are confident, moreover, that we are on the threshold of this important development, that we are, in fact, entering a new epoch. What is the basis of this optimism? In other words, what are the present trends in weather service? There are several of them. Let us briefly examine two. They are:

First, a more detailed and intensive type of service than has heretofore existed.

Second, the development of a forecasting technique based on sound physical laws, utilizing for this purpose the greater abundance of observational material only recently available.

First, then, let us consider the tendency to organize weather service in a more detailed and intensive way than formerly. Aviation is more largely responsible for this than is any other activity, but a beginning had previously been made in connection with the protection of citrus and other fruits from frost. About a quarter of a century ago it was found that the ordinary generalized type of forecast did not meet the needs of fruit growers. Accordingly, first in California and later in other sections of the country, a special service was set up which provided for frequent observations from a close network of stations in and near the fruit districts, and short period, specific forecasts issued in the evening for the following morning. This enabled orchardists to take protective measures by lighting fires in the groves, thus keeping the temperatures above the danger point. Millions of dollars worth of damage have been prevented by this service.

Undoubtedly, however, the greatest impetus to the organization of this special type of service was given by aviation. For this activity it is vital that weather conditions be reported with great accuracy not only along the airways but also for a considerable distance on either side in order that the development of unfavorable weather may be predicted before it reaches the flying routes. Moreover, the general daily forecasts were found quite inadequate. It was necessary to develop a new type, very definite and covering a period of about the same length as that of the flight itself. Accordingly, for the most active airways there are now hourly reports from a dense network of stations and six-hourly forecasts, special attention being given to such unfavorable conditions as fog, low clouds, poor visibility, squalls and ice formation. The result has been greater regularity of schedules and a marked decrease in accidents. There

is room for much improvement, but, within the limits of the funds that have been provided, as rapid progress as possible has been made, and you will be interested to learn that an increase in the appropriation will enable us to strengthen this service very materially after July 1 next.

These two examples show, somewhat dramatically, the benefits that result from an intensive type of weather service. The question naturally arises: If good for them, why not for other activities also? The answer is that we are tending in that direction right now. Let me cite a few examples.

It is scarcely necessary for me to tell my present listeners that a most direct relationship exists between weather conditions and agriculture. You undoubtedly know that, during the crop growing season, weather reports are received from a large number of sub-stations, supplementing our larger primary stations such as Kansas City. The data thus secured, when summarized and studied, make possible an estimate of the probable yield of wheat, corn and other crops, this estimate becoming more definite, of course, as the season advances, but being very helpful also even in the early months of the summer half of the year. Extensive as this service is, we realize that it can be greatly strengthened by having a considerable number of additional observing stations, particularly for rainfall which is very local in character and differs widely within short distances. This then is one of the objectives toward which we are directing attention. Not much can be done along this line right now, but we are hopeful that additional funds will later enable us to put this highly important service in a status to which it is entitled..

Time does not permit more than to name some other examples, such as the river and flood service, for which we are planning additional gaging and rainfall stations at strategic points in all river basins where floods, unless accurately forecast, cause immense damage and danger to life; again, the fire-weather service which is shortly to be considerably enlarged and which, even in its present skeletonized form, warns in advance of weather conditions, such as low humidity, thunderstorms and high winds, that are favorable for the inception and spread of destructive forest fires. Another example is the recently organized hurricane warning service which provides for hourly reports from stations along the Gulf coast, frequent reports from ships in the Gulf, the West Indies and the Caribbean, and forecast centers at New Orleans and Jacksonville. Finally, there is the marine weather service which should be, and we hope soon can be, materially strengthened by providing for regular reports from all ships four times each day instead of twice as at present. Experience has conclusively shown, not only the high importance of these more detailed reports as current information, of benefit to both marine and aerial navigation, but also their great value in indicating the development of storms which shortly approach and travel across land areas and thus affect the lives and activities of all of us.

Now, the question arises, what are we doing with all this increasing wealth of material? That brings us to the second of our recent trends in weather service, namely, developing forecasting as a science based on sound physical laws. Doubtless all of you have heard something about air mass analysis. In brief, it means simply a study of the physical structure of the various masses of air which, originating from different regions and

having different characteristics of temperature, moisture and wind, eventually meet somewhere and, because of their widely different structure, engage in a conflict, so to speak, to determine which is master, the result being a turbulent and unstable condition, gusty and squally winds, rain, snow, thunderstorms; in other words, practically everything that we denote as "bad weather". The theory of all this has been known for a long time, but weather services have never been able to apply it in a practical way, to any large extent, because of the lack of necessary data. Now we are getting the data, in increasing measure, as I have already told you. We are using the information in making detailed physical analyses of each day's weather map, including particularly the conditions in the upper air, as measured and reported for us by balloons and airplanes. The result already is a definite, even though small, improvement in the precision and accuracy of forecasts, and we feel assured that, with a continuation and further intensification of the program, forecasting is destined to develop to a plane of efficiency far higher than could otherwise have been attained.

With the subject of forecasting is always associated the question as to the possibility of extending the period to include several days, weeks, months, possibly a year or more. Among scientists there is a wide diversity of view as to whether or not such forecasts will ever be possible, but their economic and social benefits would be so vast that we should be recreant to our duty, as a Government agency, did we not bend every effort to the solution of this problem. Accordingly, we are investigating the subject with renewed energy and with a determination to run down every reasonable, that is to say, every scientific approach. We are confident that some extension of the daily forecast to 2, 3 or even 4 days ahead will be possible and that the more general weekly outlook will be somewhat lengthened. Further than this I can only express the hope that our present studies, and others to be taken up later, will yield a basis, possibly, for general statements as to the weather a month, a season or even longer ahead, but I must emphasize that this at present is only a hope.

In conclusion, it is fitting to say that the increasing interest in weather service is extremely encouraging. The public generally is becoming more and more "weather conscious". This state of mind, the organization of advanced courses in meteorology at some of our leading educational institutions and the development of increasingly efficient instrumental apparatus, particularly the radio meteorograph for observing conditions at great heights, all point to a future in weather service that will regard the past as merely an introductory chapter.